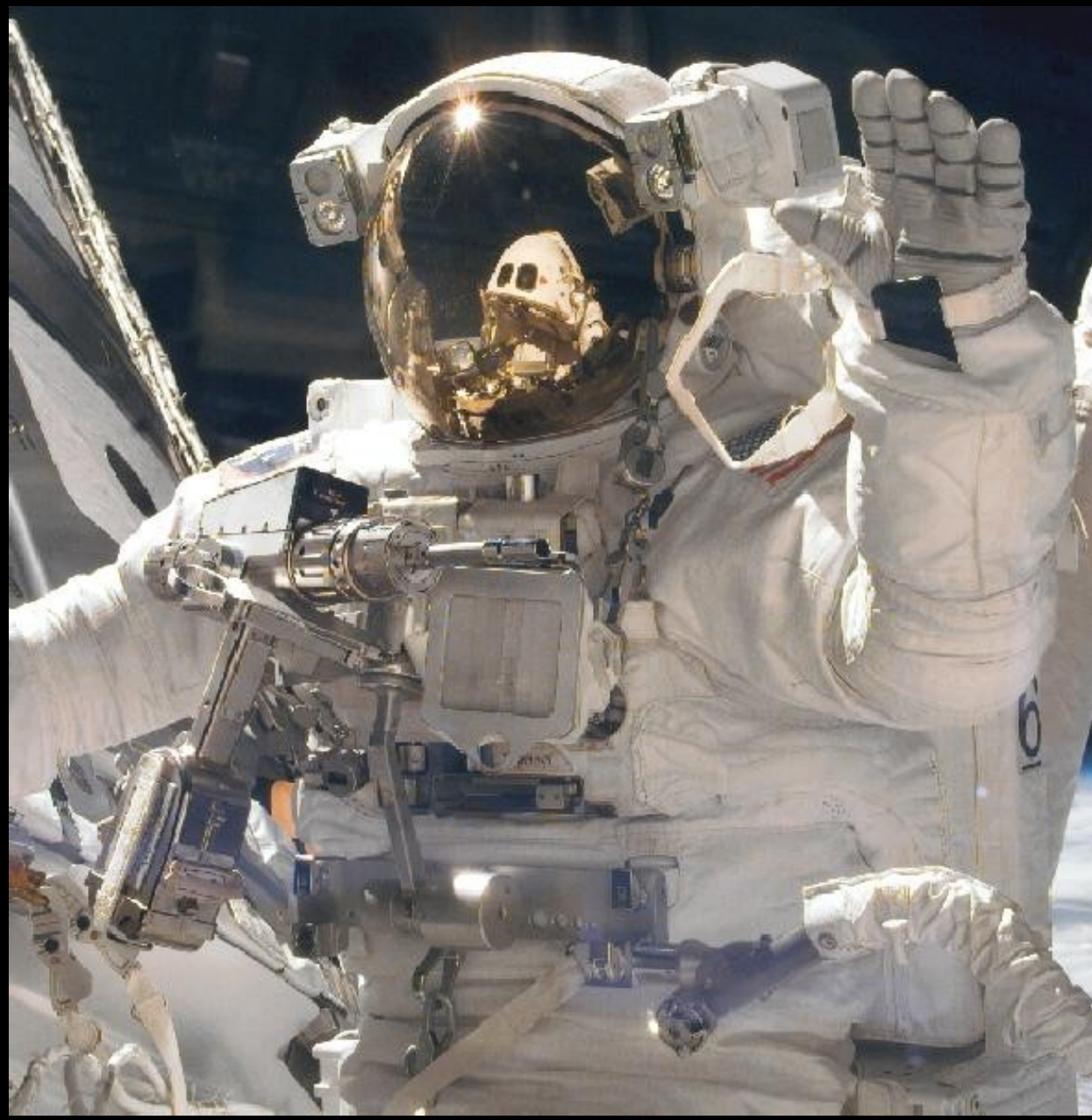
Fostering a Project Management Legacy through Technology Spinoffs

March 2004



NASA's

DECLARATION OF POLICY AND PURPOSE

Sec. 102.

"(c) The Congress declares that the general welfare of the United States requires that the National Aeronautics and Space Administration (as established by title II of this Act) seek and encourage, to the maximum extent possible, the fullest **commercial** use of space."

Rationale Behind Technology Transfer

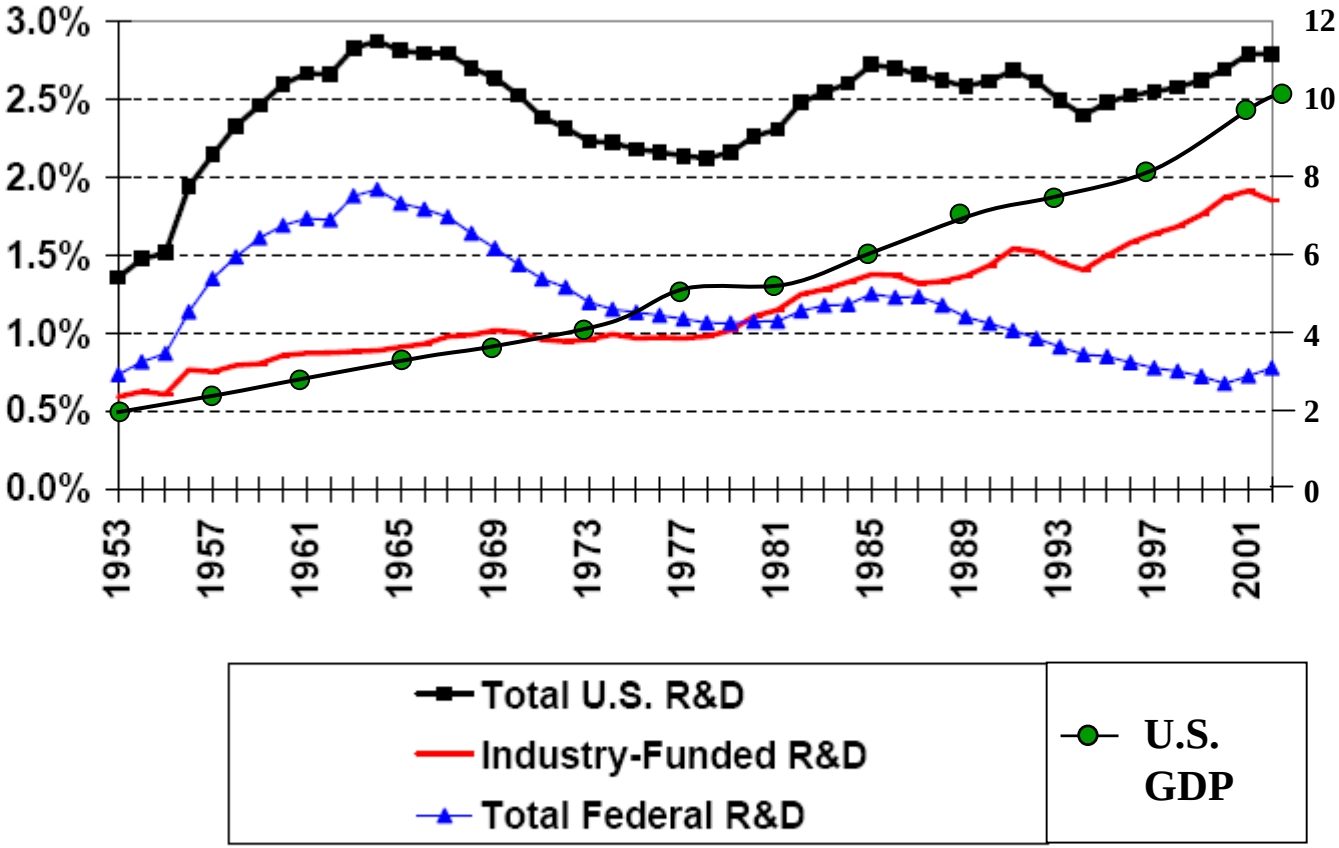
The Bottom Line:

"It's in our economic interest"

- Technology and innovation is the economic growth engine of our society.
- 2nd and 3rd tier level economies are seeing this and are initiating their own space programs.
- The next few charts represent a short measure of our U.S. investment and return

U.S. R&D as Percent of Gross Domestic Product

Total, Industrial, and Federal R&D - 1953-2002



GDP $ in Trillions

Source: NSF, Division of Science Resources Statistics. 2001 and 2002 data are preliminary. R&D funded by other sources (universities, nonprofits, etc.) included in Total U.S. R&D. Includes defense and nondefense R&D.

GDP Ref: Louis Johnston and Samuel H. Williamson, "The Annual Real and Nominal GDP for the United States, 1789 - Present." Economic History Services, March 2004.

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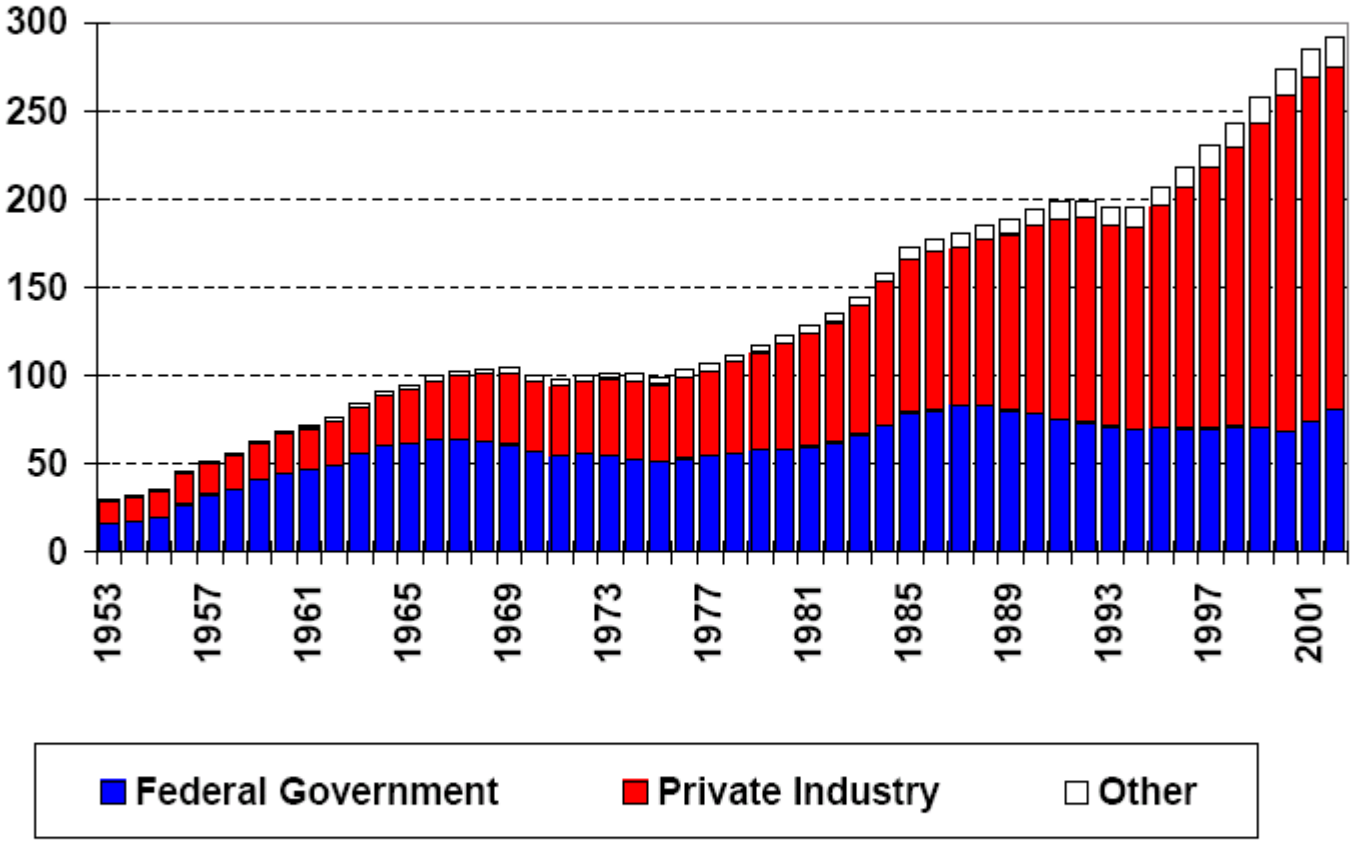
U.S. R&D Funding by Source, 1953-2002

expenditures in billions of constant 2002 dollars



Source: NSF, Division of Science Resources Statistics. (Data for 2001 and 2002 are preliminary.)

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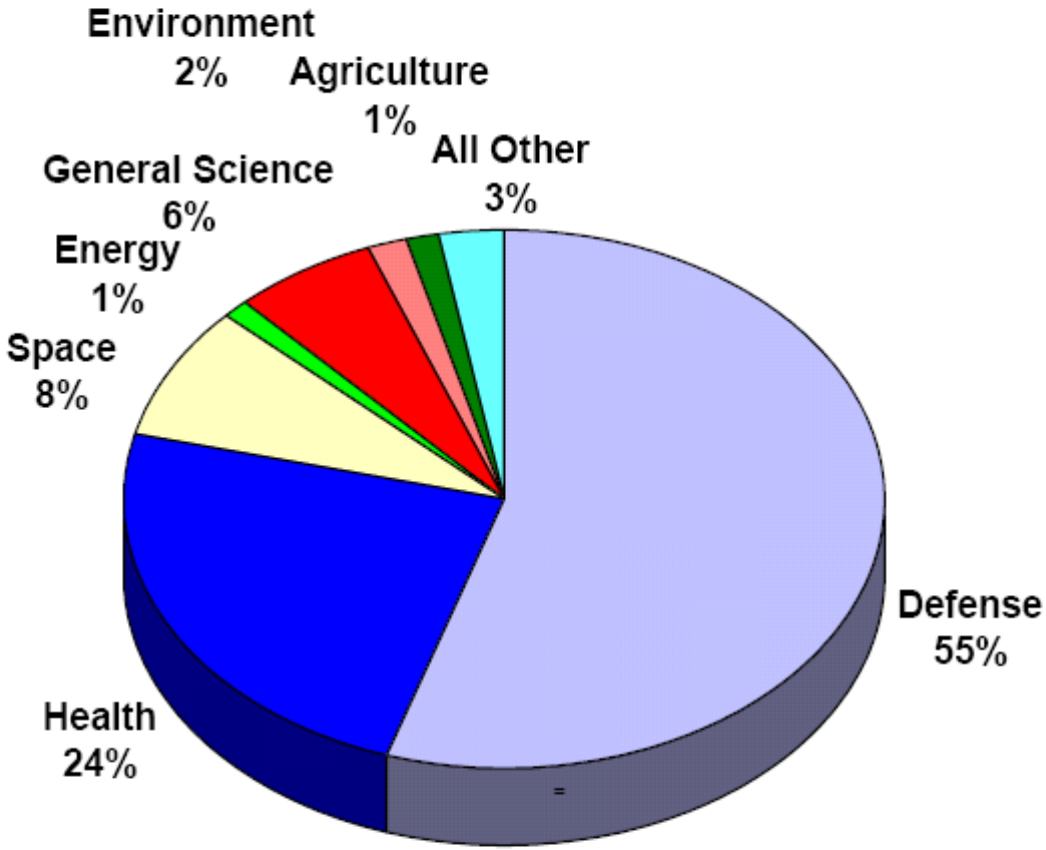
Major Functional Categories of R&D

FY 2004 President's Budget



TOTAL R&D=
$122.5
BILLION
(revised)

* - includes natural resources R&D
Source: AAAS, based on OMB and agency budget data.
MARCH '03 REVISED

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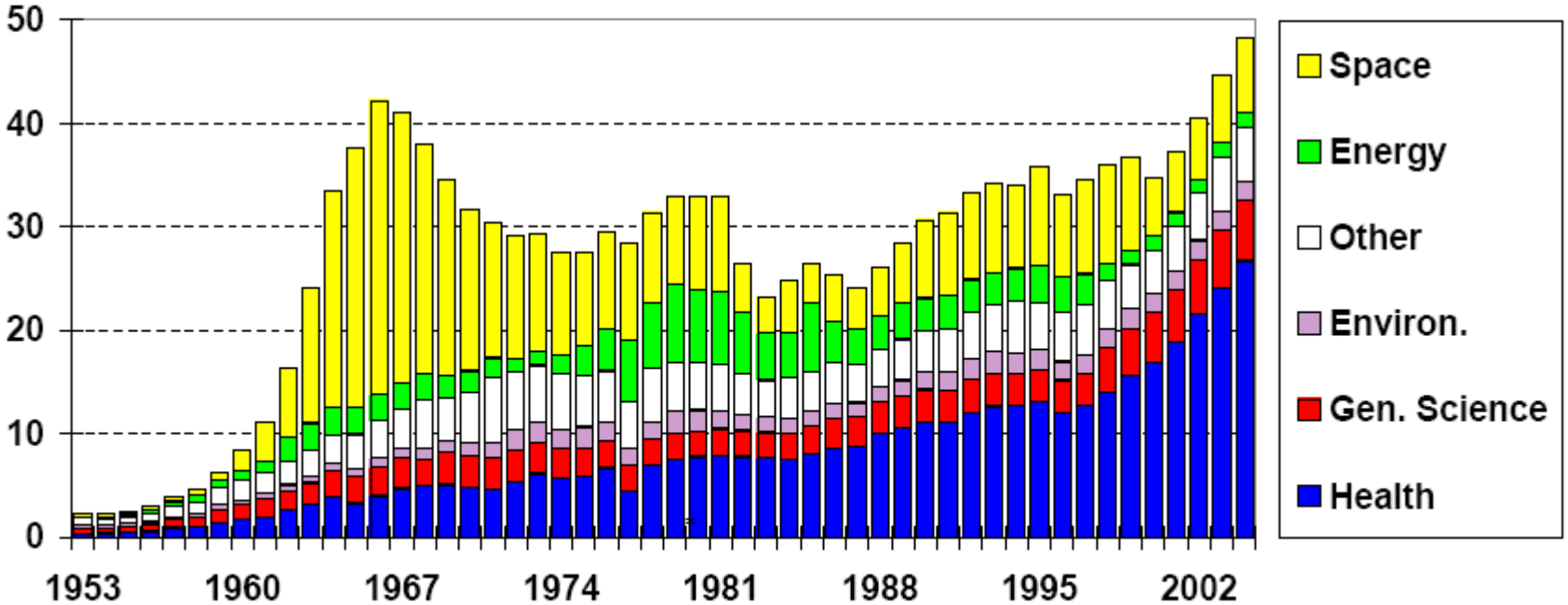
Trends in Nondefense R&D by Function, FY 1953-2004

outlays for the conduct of R&D, billions of constant FY 2003 dollars



Source: AAAS, based on OMB Historical Tables in *Budget of the United States Government FY 2004*. Constant dollar conversions based on GDP deflators.
FY 2004 is the President's request.
Note: Some Energy programs shifted to General Science beginning in FY 1998

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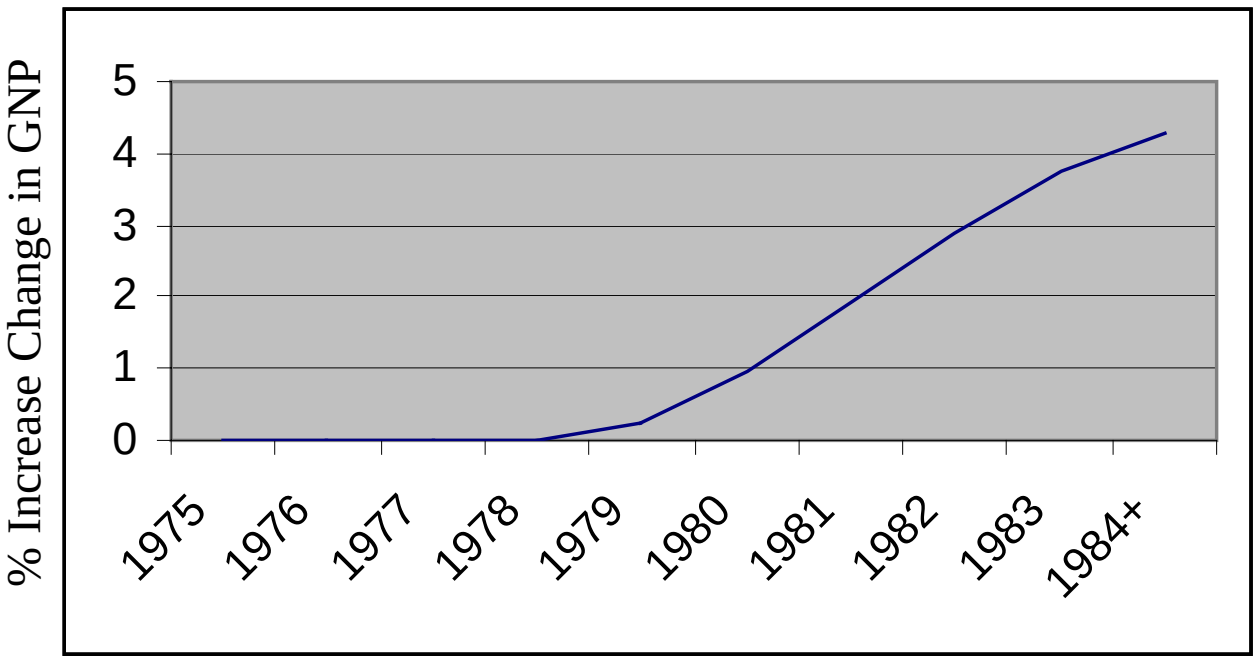
Increase in GNP per Unit Increase in NASA R&D Spending
"Pure" Productivity Effects Only



Year	Cumulative % Increase in GNP
1975	0
1976	0
1977	0
1978	0
1979	0.26
1980	0.96
1981	1.90
1982	2.88
1983	3.74
1984+	4.26

Ref: Logsdon, John M., Exploring the Unknown, Vol. III, p. 421

Global Implications of Space Research and Development

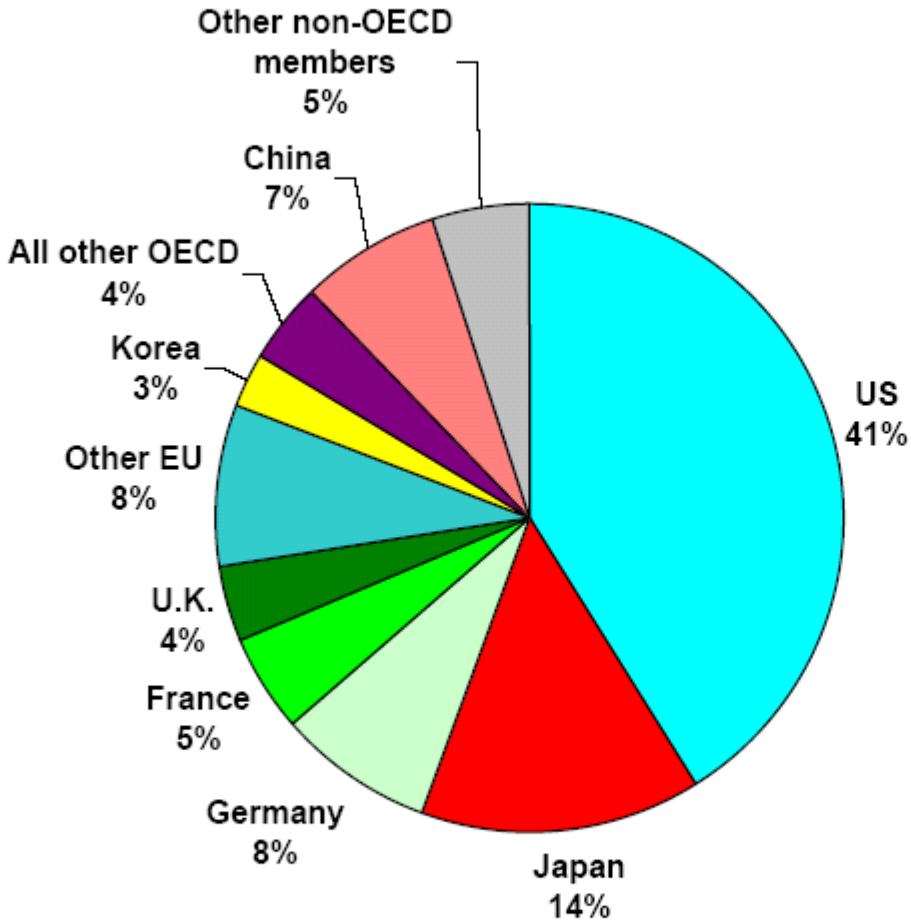
Even 2nd and 3rd tier countries are creating space programs because it is in their best economic interest.

First Tier Economies: U.S., Britain, European Space Agency (ESA), Canada, France, Germany, Italy, Russia,

Second Tier Economies: China, Hungary, Indonesia, Mauritius, Norway, Sweden, Syria, The Netherlands and Ukraine, Israel

Third Tier Economies: Asia, Africa, Chile, India

Shares of Total World* R&D, 2000



Total World* R&D = U.S. $686.9 billion**

* World = OECD members plus Argentina, China, Romania, Israel, Russian Federation, Singapore, Slovenia, Taiwan

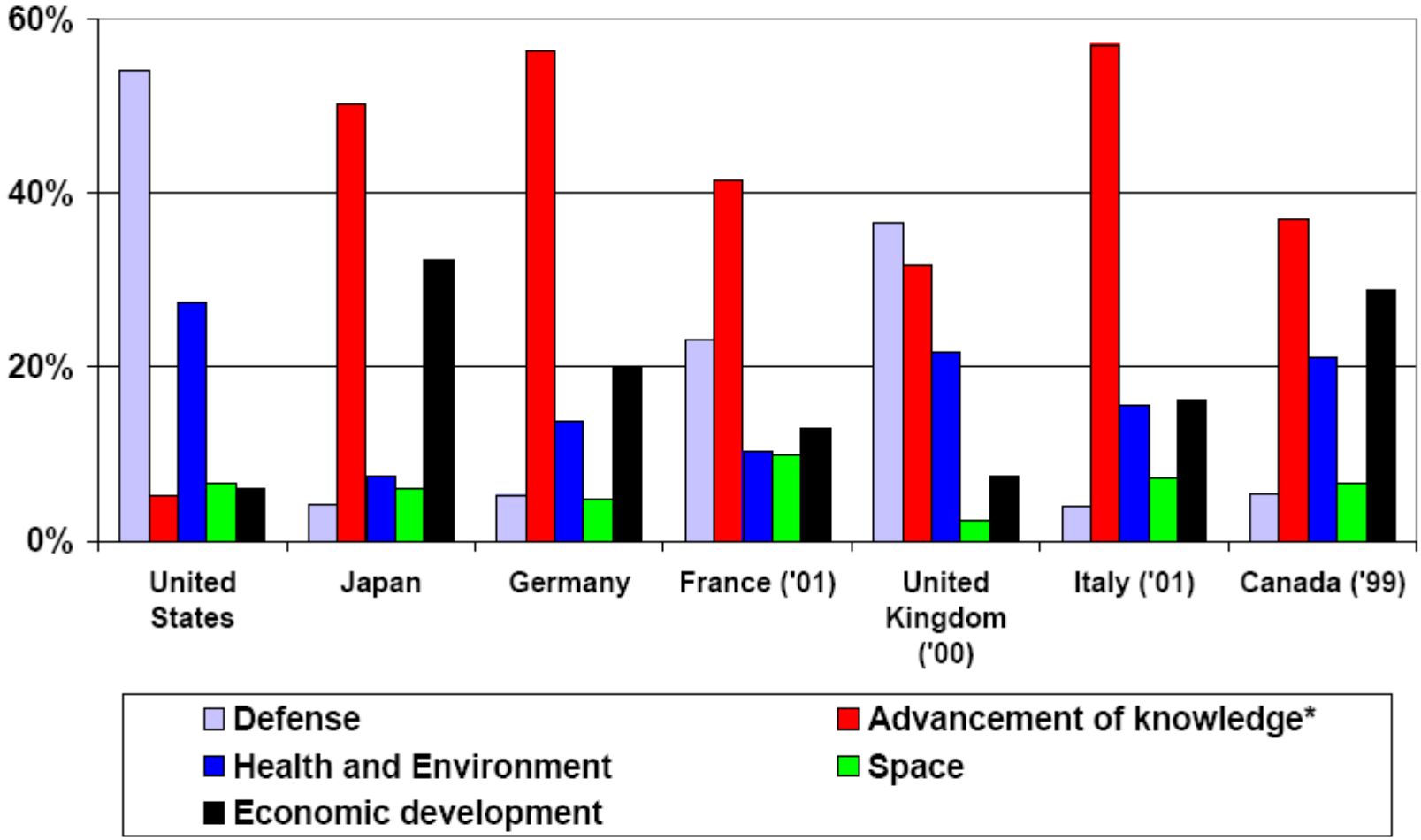
Source: OECD, Main Science and Technology Indicators, 2002.

Total R&D as Percent of Gross Domestic Product (GDP)

Nation	Total R&D / GDP Ratio	Gov't R&D / GDP Ratio	Industry R&D / GDP Ratio
Sweden 2	3.78%	0.93%	2.56%
Finland	3.37%	0.88%	2.37%
Japan	2.98%	0.64%	2.16%
United States 1	**2.82%**	**0.76%**	**1.92%**
South Korea	2.65%	0.64%	1.92%
Switzerland	2.64%	0.61%	1.82%
Germany 1	2.53%	0.78%	1.68%
France 1	2.20%	0.84%	1.15%
Netherlands	1.97%	0.72%	1.00%
Canada 1	1.94%	0.62%	0.82%
European Union	**1.88%**	**0.65%**	**1.05%**
United Kingdom	1.85%	0.53%	0.91%
Australia	1.53%	0.71%	0.70%
Italy	1.07%	- -	- -
Spain 1	0.97%	0.36%	0.47%
Mexico 2	0.43%	0.26%	0.10%

Source: OECD, Main Science and Technology Indicators, 2002.

Government R&D Expenditures by Country and socieconomic objective, 2002 (% of gov't R&D)



* - includes general university funds.

Source: OECD Main Science and Technology Indicators, 2002.

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Project Management Challenge:

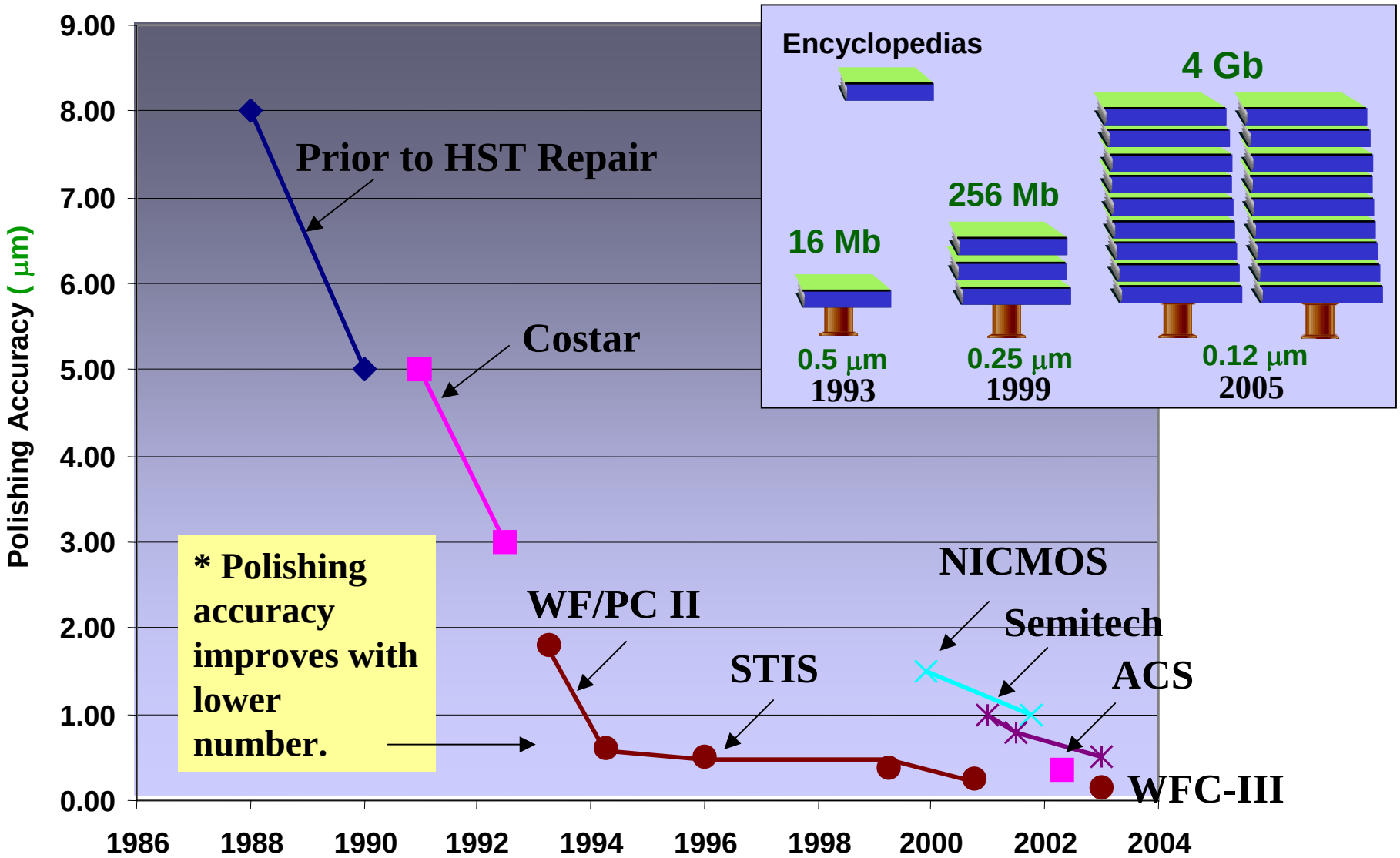
Identifying the Legacy

"What We Must Do" and "Who We Must Be"

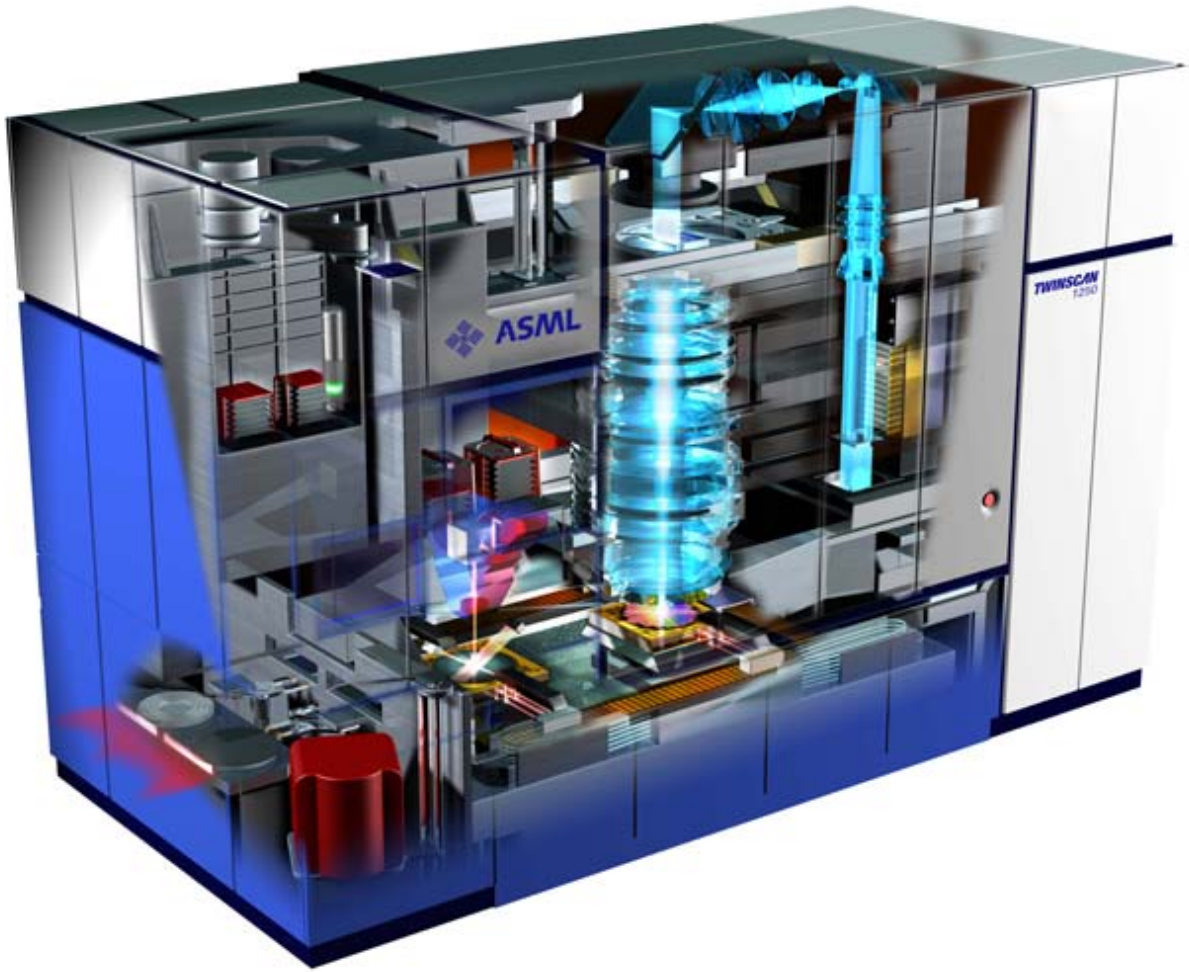
- What should a project manager's technological legacy be?
- How to flag potential spinoffs?
- How to promote the commercial or sociological applications?
- How to provide emphasis to serendipitous innovations?

Three very limited examples of technology spinoffs follow.

Unexpected Benefits – Pushing Optical Technology

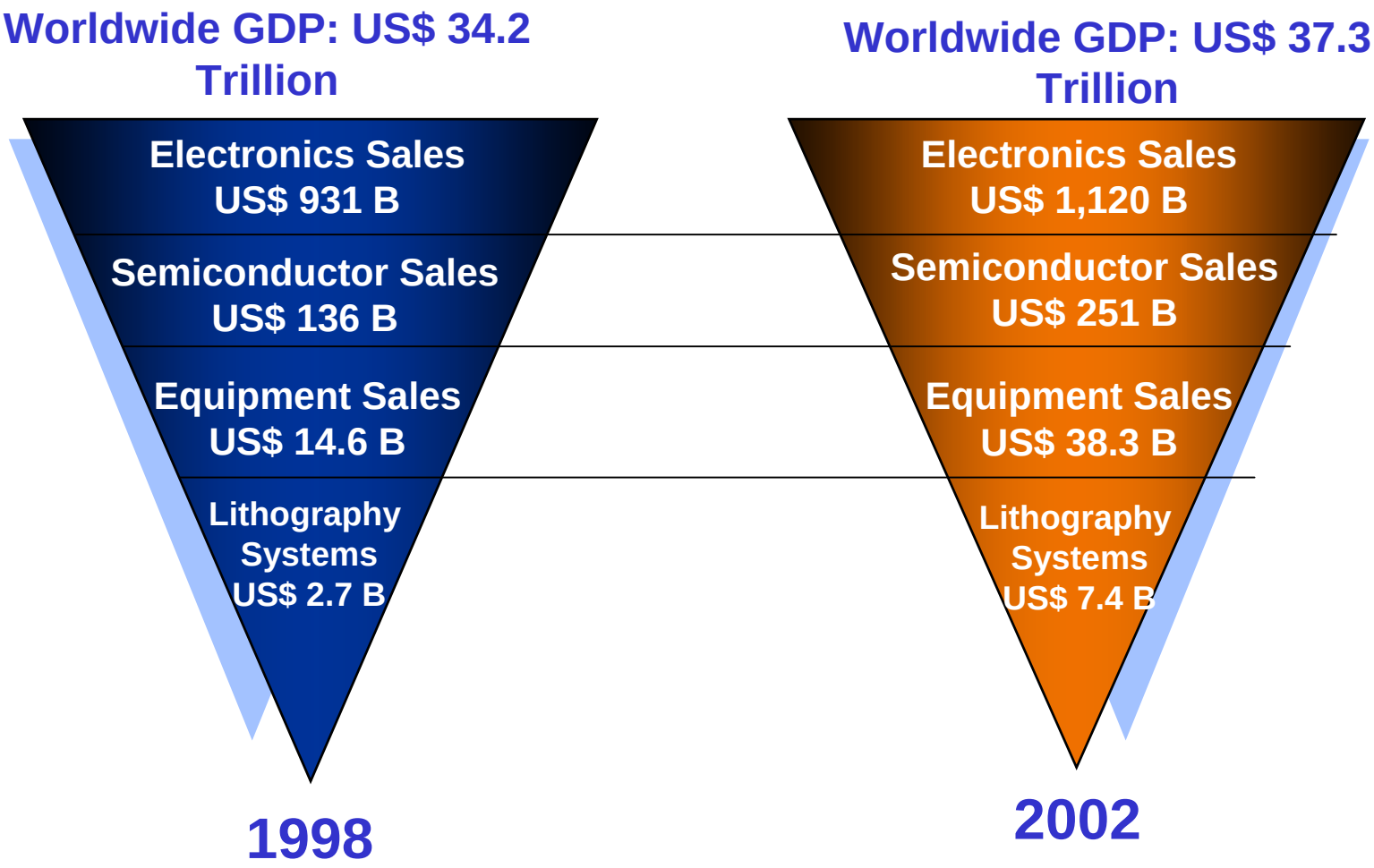


TWINSCAN XT:1250
Extending to the 65 nm node



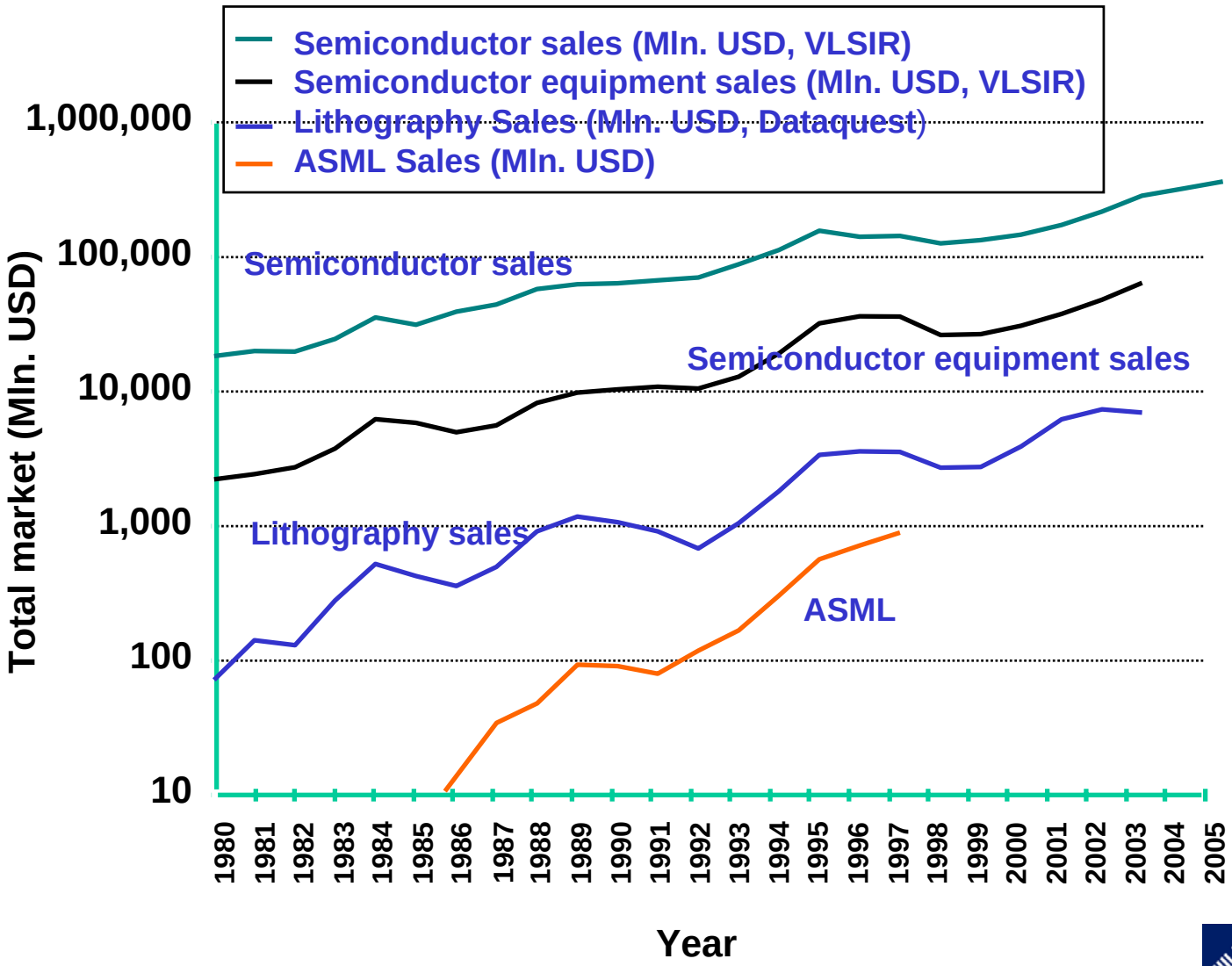
This company recognizes a valid connection between the Hubble Space Telescope optics used to explore the universe and Microlithography Optics vital to pattern electronic life on Earth.

The Semiconductor Food Chain



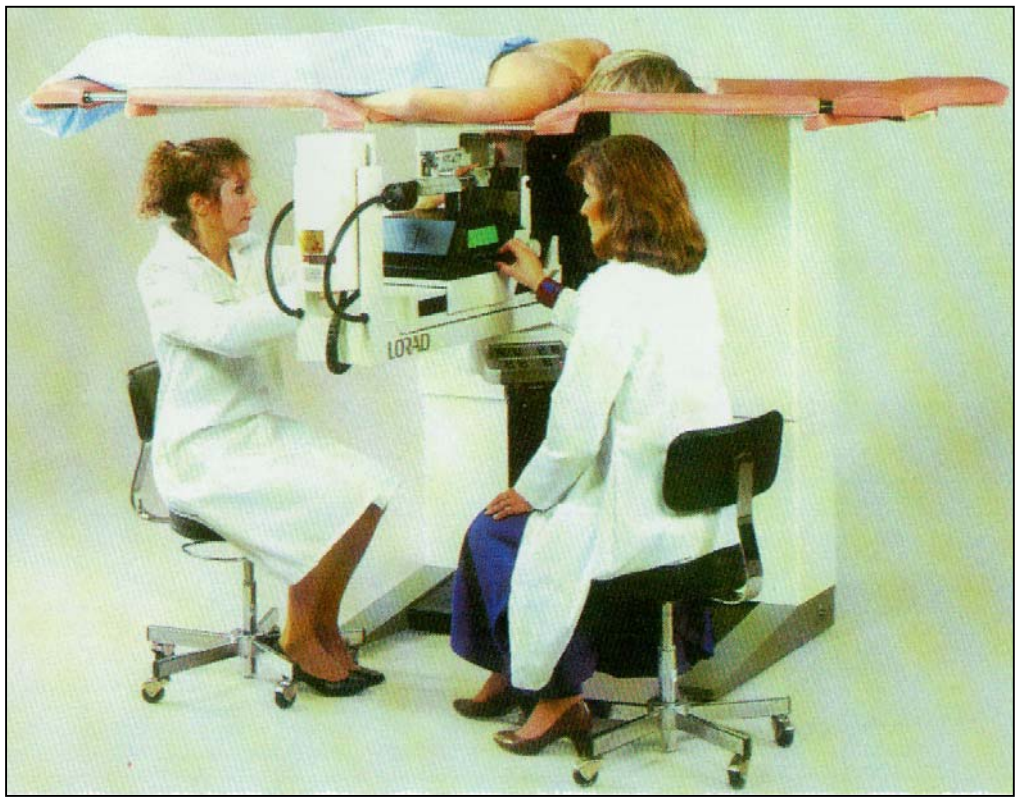
Source: Dataquest as of Jan 2000, VLSI Research

The Lithography Food Chain



One Example of Socio-Economic Impacts

Partnership impacts and spinoffs spill over into the general public by virtue of rapid mission technology turnaround.



Stereotactic Breast Biopsy System replaces surgery.

- By 1994, 500,000 women per year underwent open surgical biopsy to detect breast cancer. Patients endured the trauma of surgery although results show 80% were cancer-free.
- Digital imaging technology from HST's next-generation instrument, the Space Telescope Imaging Spectrograph (STIS), was adapted to a new, non-surgical breast biopsy technique two years before STIS was installed on HST.
- This technique—the stereotactic large-core needle biopsy—is performed under local anesthesia with a needle instead of a scalpel in hundreds of health facilities. This new method saves patients time, pain, scarring, radiation exposure, and money.
- In most cases, this technique now replaces the surgical biopsy as the method of choice—offering a far less traumatic and painful option at 1/5 the cost of surgery, saving over one billion per year in medical expenses.

Opportunities to Develop Materials in Space
"NEVER GIVE UP"

Electrophoresis Process: A spinoff that apparently failed – or DID IT?

Example: Pharmaceuticals manufacturing in microgravity

- In the 1970s, McDonnell-Douglas teamed with Johnson & Johnson to conduct a series of studies on the space processing of very critical body hormones.
- Experiments with improved electrophoresis process on shuttle, proved that critical drugs could be manufactured in space.
  - -- Erythropoietin (Procrit): Stimulates the production of new red blood cells (anemia, end-stage renal disease, kidney disease, dialysis patients).
- $30M was invested by McDonnell Douglas in conjunction with Johnson & Johnson for an STS cargo bay manufacturing facility.
- Then came the Challenger accident and all development was cancelled – an apparent total failure…….. Or was it??

Opportunities to Develop Materials in Space
"NEVER GIVE UP"

TODAY

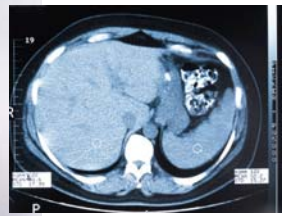
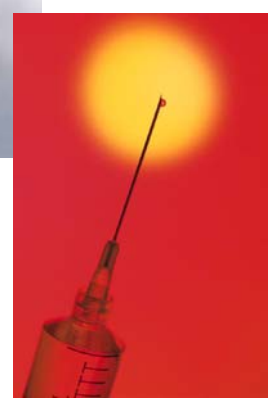
- In 1986 J&J decided that they had enough experience in the development of Erythropoietin that they went ahead and developed a synthetic version and proceeded with the FDA approval process despite a major change in direction.
- In 1998 J&J had $1.45B in Procrit sales and had expected growth of 25% each year thereafter.
- In 1998, total EPO Erythropoietin global sales was expected to reach $3.7 billion , and would rise to $7 billion in the following 5 years.

TOMORROW

I predict at least 1 in 3 of us will be candidates of this drug.

NASA Spinoffs – Health and Medicine

OTHER Examples


- **DIGITAL IMAGING BREAST BIOPSY SYSTEM**
- **BREAST CANCER DETECTION**
- **LASER ANGIOPLASTY**
- **ULTRASOUND SKIN DAMAGE ASSESSMENT**
- **HUMAN TISSUE STIMULATOR**
- **COOL SUIT**
- **PROGRAMMABLE PACEMAKER**
- **OCULAR SCREENING**
- **AUTOMATED URINALYSIS**
- **MEDICAL GAS ANALYZER**
- **VOICE-CONTROLLED WHEELCHAIR**

Other spinoffs in this area include: Arteriosclerosis detection, ultrasound scanners, automatic insulin pump, portable x-ray device, invisible braces, dental arch wire, palate surgery technology, clean room apparel, implantable heart aid, MRI, bone analyzer, and cataract surgery tools.

NASA Spinoffs – Computer Technology

OTHER Examples

- **GROUND PROCESSING SCHEDULING SYSTEM**
- **SEMICONDUCTOR CUBING**
- **STRUCTURAL ANALYSIS**
- **WINDOWS VISUAL NEWS READER (Win Vn)**
- **AIR QUALITY MONITOR**
- **VIRTUAL REALITY**

Other spinoffs in this area include: Advanced keyboards, Customer Service Software, Database Management System, Laser Surveying, Aircraft controls, Lightweight Compact Disc, Expert System Software, Microcomputers, and Design Graphics.

NASA Spinoffs – Industrial Productivity/Manufacturing

OTHER Examples

- **MAGNETIC LIQUIDS**
- **WELDING SENSOR SYSTEM**
- **MICROLASERS**
- **MAGNETIC BEARING SYSTEM**
- **ENGINE LUBRICANT**
- **INTERACTIVE COMPUTER TRAINING**
- **HIGH-PRESSURE WATERSTRIPPING**
- **ADVANCED WELDING TORCH**

Other spinoffs in this area include: Gasoline vapor recovery, self-locking fasteners, machine tool software, laser wire stripper, lubricant coating process, wireless communications, engine coatings, and engine design.

Project Management Challenge:

"WHAT WE MUST DO"

Promoting and Applying the Legacy

- Every project needs to have a core technological legacy that is able to spin back into the economy.
- NASA leverages itself through research and development by bringing on new technologies as needed through space exploration.
- **All team members** need to promote a cognitive effort during the development and flight phase of the project, purposely pushing those technologies with potential for practical applications for all the citizens.

Project Management Challenge:

"WHAT WE MUST BE AS PROJECT MANAGERS"

- Architects for the advancement of space exploration.
- Must exhibit confidence in the steps needed to advance.
- Must be visionaries about the future of exploration.
- Must have the courage and wisdom to carry that project exploration plan out beyond the life of the project, especially in technology transfer efforts.
- Above all – must have the common sense, patience, and dogged determination.

Project Management Challenge:

3 TYPES OF MANAGERS

- Those that make things happen.
- Those that watch things happen.
- Those that wonder what happened.

"Unless you're the lead dog, the view never changes…"